

## CASE STUDY

### Fault Tree Reliability Assessment

Total (UK) Exploration & Production Limited were in the process of investigating a potential over-pressure hazard resulting from the simultaneous closure of separator vessel oil, gas and water outlets on one of its offshore platforms.

Previous work carried out to judge the likelihood and acceptability of such a hazard, expressed the event probability as very low. Whilst this might be the case, a reference comparison figure is needed to determine whether or not the outcome is acceptable. Genesis Oil & Gas Consultants introduced the 'reference' by revising the original analysis to a format directly comparable with Total's corporate tolerable risk criteria. This approach provided Total with the means to assess whether or not the risk was acceptable.

#### The Challenge

Total (UK) Exploration & Production Limited operates a number of offshore installations in the North Sea environment producing oil and gas for the UK market.

During a review of one installations topside production facilities, the protection layers available on two of the oil, gas and water separators came under scrutiny with regard to a potential over-pressure hazard if the fluid flow paths blocked simultaneously.

A previous hazard review raised concerns that pressure safety valves fitted to each of the two separators were sized for gas relief only and not for three phase relief, hence there is potential for over-pressuring the separators in the event of a simultaneous blocked outlet. Total commissioned Genesis Oil & Gas Consultants to investigate the likelihood and acceptability of simultaneous blockage of all three separator outlets.

#### KEY BENEFITS

- *FAULT TREE NOW IN STANDARD FORMAT FOR HAZARD ANALYSIS EXPRESSED IN TERMS OF CORPORATE TOLERABLE RISK CRITERIA (EVENTS / YEAR)*
- *ACCOUNT TAKEN OF RELEVANT RISK MITIGATION FACTORS*
- *NEW FAULT TREE FORMAT ALLOWS VERIFICATION OF SAFETY INTEGRITY LEVEL OF PROTECTION LAYERS*

A study had already been carried out to address these concerns and concluded that the probability of simultaneous blockage of all three separator outlets was sufficiently low to be deemed acceptable. The study did not, however, state the risk acceptance criteria.

## **The Solution**

Genesis reviewed the previous study and noted that the probability assessment originated from fault tree analysis. Whilst this is a valid calculation methodology, some form of reference has to be included to determine if the low probability is in fact 'low enough'. The 'reference' in this case, was missing.

When conducting hazard analysis such as this, it is common practice to express the likelihood of the hazard as a frequency (in events / year). Each company carrying out hazardous activities in the United Kingdom has its own set of corporate tolerable risk criteria (given in events / year) to be used as a reference. With this in mind, Genesis proposed to reconstruct the fault tree analysis but change the basis from probability to frequency. Calculating the likelihood of a simultaneous blocked outlet using frequency now enables comparison with corporate tolerable risk criteria to determine if the risk is acceptable.

## **Results / Benefits**

Genesis used Total's tolerable risk criteria for safety related incidents to determine a tolerable risk of injury and/or death in the event of a simultaneous blocked outlet. The mitigating factors of operating profile, likelihood of personnel in the area, likelihood of rupture and loss of containment, likelihood of ignition and likelihood of fatality serve to reduce the severity of the target tolerable frequency to arrive at a maximum tolerable failure rate, which is then used as the reference value for comparison with the outcome of the fault tree (also expressed as a frequency). The benefit of this approach is that the hazard frequency determined by fault tree analysis is directly comparable with the corporate tolerable risk criteria. The acceptability of the

hazard is therefore a simple matter of inspection of the two values.

The fault tree analysis revised by Genesis provided Total with the assurance they were seeking since it related directly to their own corporate tolerable risk criteria.

## **About Genesis**

Genesis is a wholly owned Technip company operating on a global stage providing clients with leading edge Engineering solutions in the oil & gas market sector.

Genesis has more than 1000 employees operating from 15 locations around the world. Its aim is to add value to Client projects by applying world class expertise to each assignment.

## **About Total (UK) Exploration & Production**

Total E&P UK Limited provides integrated oil and gas services. It engages in exploring and producing oil and gas; refines crude oil and petrochemicals to produce fuel, domestic heating oils, marine fuel oils, lubricants, bitumen, and other products, including polymers that are used to make plastics; and refines crude oil to transform it into finished products, such as petrol, diesel, aviation fuel, liquefied petroleum gas (LPG), and naphtha.



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